



4th Grade Unit: “Water Systems”



Objective: *This unit will explore the water cycle and introduce students to Eugene’s three water systems, focusing on the stormwater system. Students will compare city water systems with rural systems and how stormwater impacts rural areas. Students will also examine their personal water uses and how they affect local water resources. This unit was developed to be used as an extension of the Land and Water Science Kit.*

Materials and supplies to support this lesson: *

- ◆ “Water Cycle,” “Mighty McKenzie,” “Eugene’s Three Water Systems,” “Water Awareness Test,” pdf or handouts
- ◆ Salt, cups, paint brushes, food coloring
- ◆ Water Systems poster

You will need to supply a gallon glass jar, plastic bag, rubber bands and matches for one activity

Lesson 1: What is the water cycle?

The water cycle refers to the constant recycling of the fresh water on our planet. There is always the same amount of water on the earth - no more and no less. Even though 70% of the earth’s surface is water, only 3% is fresh water. Of that 3% of fresh water, 2% is frozen in icebergs! That leaves 1% of fresh water available for people, plants and animals use. Think about it - the water you use today is the same water that was here millions of years ago. The water you drink today may be the same water that dinosaurs played in! Because there is only a finite quantity of water on our planet, it is very important to keep water clean.

The water we have now is all of the water we will ever have. In nature, water is continuously “recycled” through evaporation, condensation and precipitation.

Evaporation: Evaporation occurs when the heat from the sun causes water on the earth’s surface to turn into a water vapor.

Condensation: Once the water vapor enters the atmosphere, it cools and forms clouds. Clouds consist of billions and billions of water droplets. This process is called condensation. When the water droplets combine, they become too heavy for the cloud to hold and fall to the earth as precipitation.

Precipitation: The water that falls back to earth from the clouds is called precipitation. Precipitation can fall in many forms. Depending on the temperature of the atmosphere or the earth’s surface, it can fall as rain, snow, hail or sleet. When the ground is colder than the atmosphere, water can form fog, which is condensed moisture close to the ground. Once the water reaches the ground, the cycle starts all over again with evaporation.

Storage: Lakes, rivers, wetlands, and man-made reservoirs are places where water on the earth is stored to be available for future evaporation.

* available for teachers from the City of Eugene. See end of unit to order.



Activity 1: *The water cycle.* Give students a copy of the water cycle handout. Discuss the water cycle and have students fill in the correct words to explain the parts of the water cycle.

Activity 2: *Cloud in the bottle.* Demonstrate how water vapor condenses and clouds form by performing this experiment.

This simple experiment demonstrates how humidity, heat and air pressure influence the formation of clouds. The water in the jar (representing a body of water on earth) produces high humidity while the smoke from the match provides “nuclei” on which the water vapor can condense. As the bag is pushed into the jar, pressure and temperature increase, causing the jar to clear. When the bag is pulled out, pressure and temperature decrease, allowing water vapor to condense and produce a cloud in the jar.

Materials:

- Wide-mouth gallon pickle jar
- 1 heavy duty plastic bag
- Rubber bands
- Matches

Place about 1 cup of water in the jar. Have the plastic bag and rubber band handy. Place a lit match in the jar and immediately place the plastic bag over the jar and seal it with the rubber band. Push the bag quickly into the jar and then pull it out. Watch what happens!

After the experiment, ask the students these questions:

1. Why are smoke and water added to the jar? (the water adds humidity and the smokes provide the “nuclei” for cloud formation)
2. How does warming and cooling in the jar effect cloud formation? (warming decreases cloud formation; cooling increases cloud formation)

Activity 3: *Salt water painting.* Demonstrate evaporation by having the students do a salt water painting.

Materials:

- Salt
- Containers for paint (paper cups)
- Paint brushes
- Measuring cup
- Paper
- Warm water
- Food coloring

Divide students into groups of four or less. For each group, make salt water paint by placing 1/4 cup of salt in each container. Add 1/4 cup of warm water to each container and stir to dissolve the salt. Add food coloring to the diluted salt solution, using a different color for each group. Have students paint a picture with the salt water paint. Let the paintings dry overnight (put them near a sunny window if possible) and have the students examine them the next day. The water will have evaporated and the colored salt will remain on the paper.

To explain that all water evaporates and reforms as clouds and precipitation, use puddles in the street as an example. When the sun comes out after a late spring rain, puddles disappear quickly. Where does that water go? Remind students that water is constantly recycled and the water in the puddles evaporates and condenses into clouds. The water in the puddles still exists, but in a different form!

Ask students to write a short report explaining why the water disappeared but the salt stayed on the paper.

Lesson 2:
What are Eugene’s three water systems?

Most communities have several main water systems. Communities provide clean drinking water for their citizens and also clean and purify wastewater from homes and businesses. As our communities become larger and more land is used for homes and business areas, there also



must be a place for water to go that falls as precipitation. In Eugene we have three water systems:

Drinking water system: Eugene gets its drinking water from the McKenzie River, which is fed by melting snow and springs from the mountains. River water is pumped to a filtration plant where it is purified. Chlorine is added to kill bacteria and inactivate viruses. The water is then put through an activated charcoal filter before it is pumped to homes, schools and businesses.

Many communities do not have rivers as a source of drinking water and use above-ground reservoirs or underground wells to provide water to citizens.

Wastewater system: The water that we use for bathing, cleaning, cooking and other things is treated at the Eugene/Springfield Wastewater Treatment Plant. Sanitary sewers carry the water to the plant where it is cleaned. It is then disinfected and is released into the Willamette River. In your house, anything that you put down the sink, toilet, or bathtub goes to the treatment plant to be cleaned.

Stormwater system: Our modified landscape now includes roads, parking lots, and buildings that have replaced natural vegetation. Any surface that prevents rainwater and snowmelt from being absorbed into the ground is called an “impervious surface.” Rainwater or snowmelt that runs across these impervious surfaces is called “stormwater.” As stormwater runs off these surfaces, it picks up oil, gasoline, dirt, litter, debris from construction sites, and excess fertilizers and pesticides from our homes. This runoff can also include animal waste or waste from leaky septic systems. Stormwater flows down storm drains or into open ditches that lead to local waterways. Stormwater is not treated, filtered, or cleaned. Pollutants and debris carried with stormwater damage our lakes, rivers and streams. As a result fish can die,

too much algae can grow, and water can become unsafe for drinking or recreation.

Brainstorm: How is the stormwater system different from the drinking water and wastewater systems?

Brainstorm: What is an impervious surface? Can you identify places that include large impervious surfaces? (Streets, parking lots, the mall, building roofs). Is an umbrella an impervious surface?

Activity 1: *Eugene’s Three Water Systems.* Hand out the “Three Water Systems” poster. Discuss the differences between the three water systems.

Extension: *Create a Landscape.* Using a flour and water paste, have students create a simple landscape with porous and impervious surfaces (use sponges for porous surfaces). Students may also add trees, and buildings purchased from a hobby shop. Add “pollutants” to water and observe how the water carries the pollutants along impervious surfaces. Have students note that water and pollutants soak into porous surfaces.

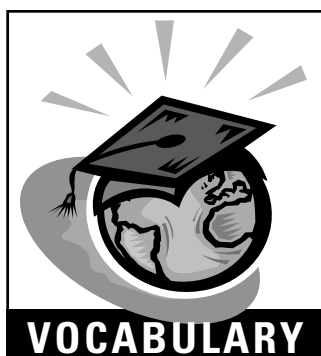
Lesson 3: Personal water use

All of use water in our everyday life. The way we use water varies from person to person. Many people do not realize that their personal water use can have an impact on local water resources in good and bad ways.

Brainstorm: Have students list ways they use water every day.

Activity 1: *The Water Awareness Test.* Handout the Water Awareness Test and assign the test as homework to be done with a parent. Have students return the test and calculate scores using the score sheet on page 25. Create a *Water Awareness Graph* for the class.

Using the 15 water activities listed on the *Water Awareness Test*, discuss conservation and wasteful water use habits. Discuss how personal water use can affect local water quality and what can be done



filtration plant
impervious surface
groundwater
wastewater
porous surface
septic tank
reservoir
stormwater

to improve personal water use habits.

Here is some information to help with the discussion of personal water use:

Do you or your family. . .

1. Leave the tap water running as you brush your teeth?

The bathroom is where the biggest savings in personal water use can be gained. Two-thirds of the water used in the average home is used in the bathroom. Running the faucet while brushing your teeth uses approximately 10 gallons of water. Instead, wet your toothbrush at the start and then rinse it once or twice through the process. This will only use about a half a gallon of water so you will save over 9 gallons of water!

2. Turn the lawn sprinkler on during the middle of the day?

By watering in the middle of the day when the sun is at peak temperature, a greater percentage of the water evaporates before it can be absorbed. Water during the cool parts of the day to keep your lawn from “burning” in the heat. To prevent lawn fungus, don’t water at night. Watering in the early morning or evening is best. During dry periods, let the grass clippings stay on the lawn to help retain moisture.

3. Throw used containers of paint, solvents, or harsh cleansers in the trash?

Many products found in the home can pose a health or environmental hazard if they aren’t disposed of properly. Anything labeled as toxic, flammable, corrosive, reactive, infectious, or radioactive can threaten family health and safety.

According to national estimates, each home contains from three to eight gallons of hazardous materials in kitchens, bathrooms, garages, and basements. Throwing them in the garbage can threaten sanitation workers who can be injured or poisoned by acids, fires, and explosions. Hazardous wastes that reach our landfills can leach into the soil, pollute water, and threaten all living things. Read the

product label carefully to determine the best method of disposal.

4. Empty leftover paint, solvents, or cleansers into the kitchen sink or down storm drains?

Substances poured into household drains and toilets go to the sewage treatment plant where they are cleaned. However, the water is eventually discharged to the Willamette river where it can impact fish and wildlife if the toxics overload the system. The sanitary system was built to handle sanitary wastes, not hazardous wastes. Even worse, if these products are poured down storm drains, they flow directly to our waterways.

As alternative options, plan your project carefully and buy only what you need. If you do have products left over, give them to friends, neighbors, or charitable institutions to use. Allow small amounts of paint to harden in their original containers, then wrap in newspaper and dispose in the trash. It’s O.K. to rinse brushes and rollers from some types of paints in an indoor sink, but never pour paints, solvents or cleansers down the drain. Check product labels carefully for disposal options.

5. Run the washing machine or dishwasher with small loads?

In the kitchen, the largest water consumer is the dishwasher – about 12 gallons per run. It’s best to make sure your dishwasher is fully loaded before you turn it on, because you’ll use 12 gallons whether you’re washing a 10-piece dinner setting or a few cups. Shorter cycles are another way to conserve water. Scrape your dishes into the trash before loading; rinsing is not necessary for most dishwashers.

If you are the dishwasher, don’t run the water while doing the dishes. Fill a sink with soapy water, wash the dishes and set them on the counter. When you’re done with the soapy water, drain the sink and refill it with clean water for rinsing.

6. Water your lawn frequently during the summer to achieve a lush cover?

Water only when the grass or plants show signs of needing water. If you can see your footsteps when you walk across your lawn, it's time to water. Water deeply, slowly and infrequently to develop a strong root system. Healthy lawns resist disease, require less herbicide and pesticide, and stand up to wear. In combination with rain and sprinkling, give your lawn about one inch of water per week. Water an additional half inch to one inch during dry periods.

7. Use lots of fertilizers and lawn feeder to help the lawn recover from winter?

Before you put toxic chemicals into your daily living space, consider whether they're needed. Have your soil tested to determine what, if any, amendments should be added. Plan your landscape with environmental health in mind, reducing the area that is heavily maintained. Limit the use of toxic or hazardous products. Keep the products away from storm drains, lakes, and streams.

8. Clean the driveway, sidewalk or curbside by hosing it with water?

As well as wasting water, hosing collects the surface pollutants on the driveway, sidewalk, or curbside and washes them directly into the storm drain where they flow untreated into our creeks and rivers. Use a broom to sweep up the debris and dispose of it in the trash.

9. Leave the shower running to heat up the bathroom?

Run the water only as long as it takes to get it warm and then get in quickly. Use an energy efficient showerhead to make your hot water go a long way. This not only save water, but the cost of heating it. For example, a five-minute shower using a regular showerhead uses 30 gallons of water. That same shower using

an energy efficient showerhead uses only 12.5 gallons. Energy efficient showerheads are available at many local stores. They can help save thousands of gallons of water each year!

10. Wait to repair a dripping faucet until it turns into a steady leak?

A dripping faucet can add up to gallons of wasted water every week. The repair may be as simple as replacing a worn washer or gasket. Your nearby hardware store sells repair parts for most makes and models and has staff to assist you in choosing the right part. You may also find a "how to" sheet to help the process as well. If the repairs are more extensive, consider calling a friend or a plumber.

11. Use the toilet to dispose of ordinary waste around the house?

Every time a toilet is flushed, about seven gallons of water go into the sanitary sewer system and on to the Wastewater Treatment Plant. To cut down on this waste, don't use the toilet as a trash can (for tissues, gum wrappers, cigarette butts, etc.). Reduce the amount of water per flush through two options: 1) Replace your conventional toilet with a water efficient "low flow" model which uses only 1.6 gallons of water per flush; or 2) Reduce the amount of water your conventional toilet uses by filling plastic containers with water, seal, and place in the tank of your toilet. You'll save about four gallons of water per day.

12. Wash the car every weekend in the summer?

A less frequent schedule would save gallons of water. When washing your car, use a bucket for soapy water and use the hose only for rinsing. Use a shut-off trigger sprayer to control the water flow. Running the hose in the driveway doesn't get the car any cleaner. Park the car on your lawn or gravel driveway so the ground can filter out the soap and pollutants. Don't let the soapy water run off



into the street where it flows into storm drains and waterways. Consider using only water and a sponge to clean the car without soap. Or, take the car to a commercial car wash where the soapy water drains to the Wastewater Treatment Plant rather than the stormdrain system.

13. Change your oil in the street or use storm drains to dispose of used oil?

When you dump oil (or anything else) into the storm drains, it goes directly into creeks and wetlands, and eventually ends up in the Willamette River or Fern Ridge Reservoir. If you change your oil at home, use a tarp under your work surface to catch drips and spills. Collect the oil and drain the oil filter into a sealable, non-breakable container that is clearly marked and set it out for pickup by your waste hauler. Check with your waste hauler for more information about quantity, limits and pick-up frequency.

14. Sweep lawn trimmings into the curb or down storm drains or toss into creeks or ditches?

When you sweep lawn trimmings into the storm drain, surface pollutants or chemicals are swept along with them. All of these pollutants are carried with stormwater directly into our local waterways where they harm fish and wildlife. When dumped into creeks, lawn debris (perhaps with fertilizers and pesticides still attached) begin to decompose. The decomposition process requires oxygen — robbing it from the creek where fish and plants need oxygen to breathe. Left in a ditch, the trimmings clog the water flow and could cause flooding. Avoid these problems by collecting the lawn clippings for your compost pile or allowing the fine clippings to remain on the lawn to retain moisture and reduce watering costs.

15. Use a garbage disposal to get rid of food scraps?

While grinding up small amounts of food waste is the purpose of a garbage disposal, avoid using it as a trash can.

The amount of water required to flush the materials adds up quickly. Scrape dishes into the trash rather than down the drain and save leftovers to make your grocery dollars go further. You may also want to set up a simple compost pile or worm bin using food scraps. To learn more about home composting, visit the City of Eugene's Solid Waste and Recycling Program at eugenerecycles.org.

Lesson 4: City and Rural Water Systems

As we learned in Lesson 2, there are three water systems in the City of Eugene. Drinking water is treated to make it safe and wastewater is treated so it becomes safe to put back into the Willamette River. Only stormwater is not treated. Are there three water systems in the rural areas outside the city? How do people in rural areas get drinking water? How is household waste treated? Are there storm drains?

When we look at a rural landscape and compare it to a city landscape, the differences are obvious. Rural landscapes consist of open fields, farmland, and forests. People who live in rural areas are more spread out on larger properties than city inhabitants. There are fewer houses and streets, no office buildings, shopping malls or huge parking lots. Since there are fewer impervious surfaces and no storm drains to carry stormwater away, most stormwater soaks into the ground. However, stormwater runoff is still a problem in rural areas.

Many rural residents have farms and grow crops or raise livestock. Most people in rural areas get their drinking water from underground wells that are drilled on their property. Unlike city drinking water, water from underground wells does not go through a purification process at a filtration plant. Because the water is not treated before it goes into the home, the location of the well is very



important. If the well is placed too close to livestock pens, it can become contaminated with animal waste that seeps into the ground when it rains. The well should also not be too close to farm fields where fertilizers and pesticides are applied to crops. These pollutants are also carried into the ground with the rainwater and can contaminate wells. When pollutants are carried into the soil with rainfall it is considered groundwater pollution. To make sure the water is safe to drink, it is a good idea to have the water tested on a regular basis.

Since farms are not hooked up to the public sewer systems, where does the wastewater go? Wastewater goes from the house into a septic tank. Most of the liquids from septic tanks leach from the tank to the ground. The solids must be pumped out when the tank becomes too full. Septic tanks can also contribute to groundwater pollution. It is important to make sure the septic tank is not close to the drinking water well, a pond or creek because the liquids from the tank could pollute surrounding water sources.

What happens to stormwater in places where there are no storm drains? Since there are fewer impervious surfaces in rural areas, most stormwater soaks into the ground. However, some stormwater

runs off roads, fields, and livestock pens into ditches that lead to nearby creeks, ponds and rivers. What happens when water from a big rain storm flows through a livestock pen and into a nearby creek or heavy rains fall on field that has just been fertilized?

Brainstorm: How are city and rural water systems different? Do they have some of the same problems? What can be done in rural areas to prevent stormwater pollution?



SPLASH! was developed by the City of Eugene Stormwater Management program to support education about water quality in our community. This program is funded by City of Eugene stormwater user fees.

* For more information, supplies for use with these lessons, the SPLASH! Songs CD, or a visit from Lily, contact jeffrey.j.flowers@ci.eugene.or.us or call 541-682-8482 (Eugene schools only)





Water Awareness Test Scoresheet

Find your total score below and see how aware you are about water use and water quality. Check to see if there's more you could do.

20 or less

Way to go! You know a lot about the value of Eugene's water, how to conserve it, and prevent pollution.

What else can you do?

Keep up the good work! Educate your friends and family to follow your example. Join Eugene's stormwater volunteer program, the "Stream Team" by calling 682-4850.



21 to 35

Not bad, but you can do better. You know how to conserve water and to protect our surface and groundwater from pollution, but you need to make it a habit. Remember, even small leaks result in huge losses, and a little bit of pollution can hurt a lot of water.



What else can you do?

Give your friends and family this water use survey. Whenever you find problems, put your new information to work.

36 to 45

Listen up – things need to change! Like too many others, you could be hurting Eugene's water supply and even causing water pollution. You need to learn about the many ways you can change your habits to become part of the solution.

What else can you do?

Call local organizations or government agencies for more information. Learn about and practice measures to save and protect water. Join a local group committed to natural resource protection.





Water Awareness Graph

Name: _____

TOTALS

100															
95															
90															
85															
80															
75															
70															
65															
60															
55															
50															
45															
40															
35															
30															
25															
20															
15															
10															
5															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

WATER AWARENESS QUESTIONS



The Water Cycle



Label the picture with the correct words:

Evaporation Condensation
Precipitation Storage

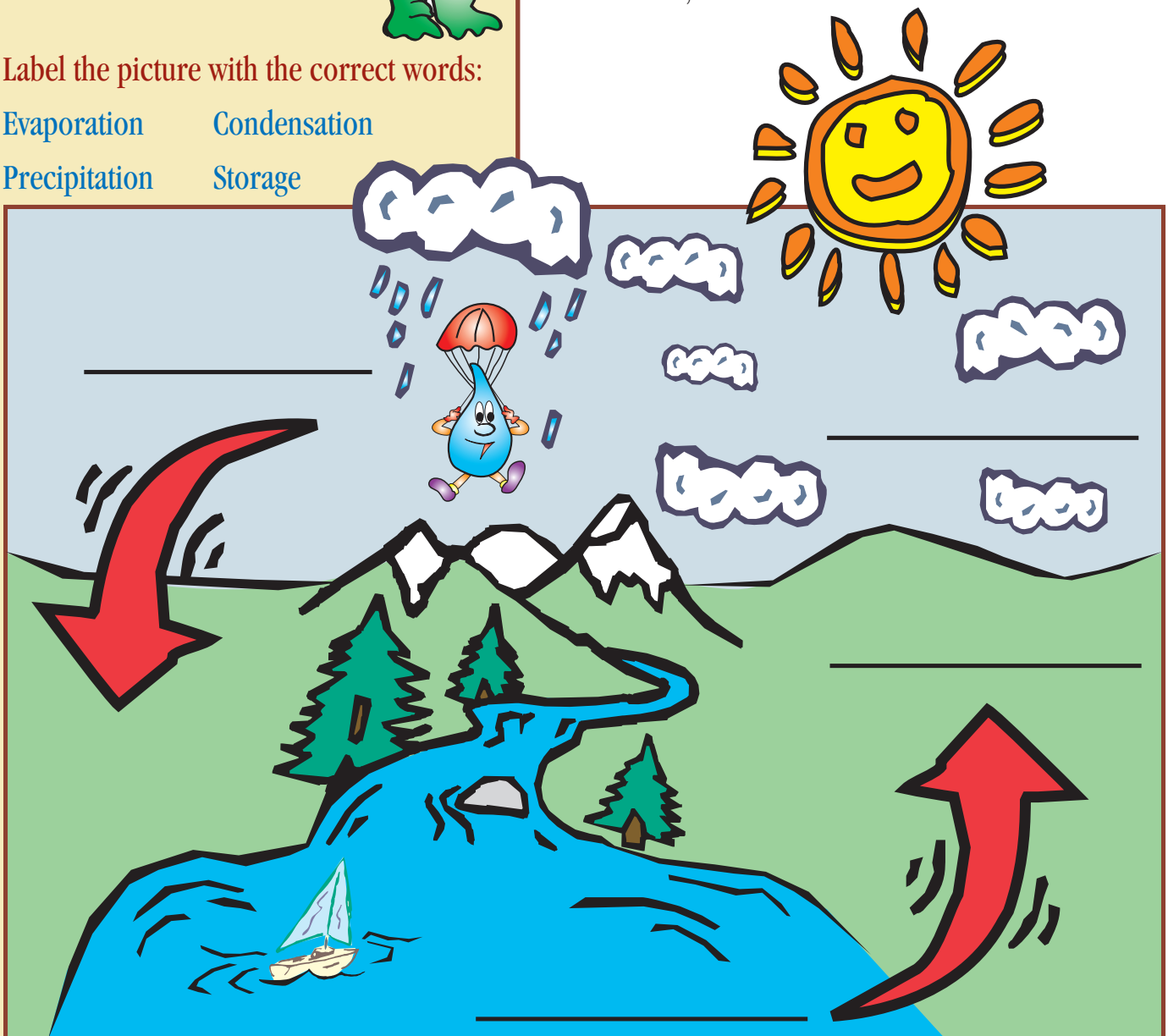
What is the water cycle?

Evaporation: Evaporation occurs when the heat from the sun causes water on the earth's surface to evaporate into a water vapor. (eVAPORate).

Condensation: Once the water vapor enters the atmosphere, it cools and forms clouds. Clouds consist of billions and billions of water droplets. This process is called condensation. When the water droplets become too heavy for the cloud to hold, they fall to the earth as precipitation.

Precipitation: The water that falls back to earth from the clouds is called precipitation. Precipitation can fall as rain, snow, hail or sleet. Once the water reaches the ground, the cycle starts all over again with evaporation.

Storage: A supply of water set aside for future use. Examples include lakes, rivers and wetlands.





Water Awareness Test

Every day we do – or don't do – things that affect the amount of water we use and the condition or "quality" of the water we pour out.

Circle the number on the right side that shows if you or your family "NEVER," "SOMETIMES," or "OFTEN" do the following things. Then add up all your numbers and see how you are doing.



FEBRUARY 2001

Do you or your family . . .

1. Leave the tap water running as you brush your teeth?
2. Turn the lawn sprinkler on during the middle of the day?
3. Throw used containers of paint, solvents, or harsh cleansers in the trash?
4. Empty leftover paint, solvents, or cleansers into the kitchen sink or down storm drains?
5. Run the washing machine or dishwasher with small loads?
6. Water your lawn frequently during the summer to make your lawn green and beautiful?
7. Use lots of fertilizers and lawn feeder to help the lawn recover from winter?
8. Clean the driveway, sidewalk or curb side by hosing it with water?
9. Leave the shower running to heat up the bathroom?
10. Wait to repair a dripping faucet until it turns into a steady leak?
11. Use the toilet to dispose of ordinary waste around the house?
12. Wash the car every weekend in the summer?
13. Change your oil in the street or use storm drains to dispose of used oil?
14. Sweep lawn trimmings into the curb or down storm drains or toss in creeks, or ditches?
15. Use a garbage disposal to get rid of food scraps?

	NEVER	SOMETIMES	OFTEN
1	1	2	3
2	1	2	3
3	1	2	3
4	1	2	3
5	1	2	3
6	1	2	3
7	1	2	3
8	1	2	3
9	1	2	3
10	1	2	3
11	1	2	3
12	1	2	3
13	1	2	3
14	1	2	3
15	1	2	3



TOTAL



The Mighty McKenzie!



Our drinking water comes from the McKenzie River. The McKenzie River starts in the mountains and travels to Eugene where it flows into the Willamette River.



Eugene's 3 Water Systems



Water is a precious, limited resource. Eugene's water resources are managed by three separate systems: drinking water, wastewater, and stormwater.

1 Drinking Water

Eugene's drinking water source, the McKenzie River, is fed by melting snows and mountain springs. River water is pumped to a filtration plant where Eugene Water and Electric Board (EWEB) removes impurities. Chlorine is added to kill bacteria and inactivate viruses. The water is then put through an activated charcoal filter before it is pumped to our homes and schools.

2 Wastewater

The Eugene/Springfield Wastewater Treatment Plant treats the water we have used for bathing, cleaning, and cooking. Sanitary sewers carry this wastewater to the treatment plant where it is cleaned through primary and secondary treatment processes. It is then disinfected before being released to the Willamette River.

3 Stormwater

Stormwater is not treated but flows through the storm drain system into our rivers and creeks. Pollutants can be washed from our driveways, roofs, and streets into the storm drain system. Keeping pollutants out of stormwater is a good way to help keep water clean.

Help Keep Water Clean

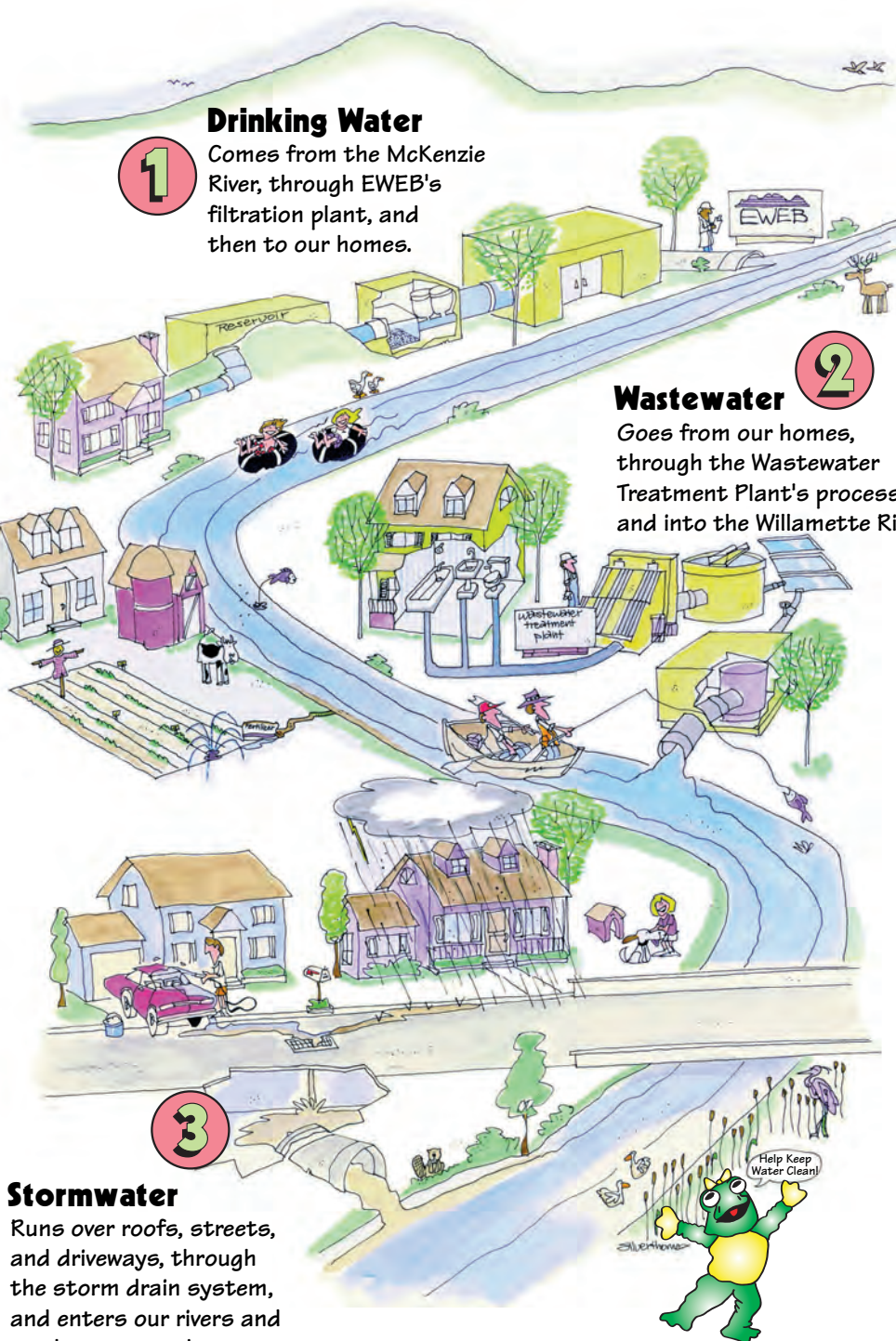
Learn how your actions can make a difference. Call Eugene Public Works Stormwater Information at 682-2739 to learn more.

Drinking Water

1 Comes from the McKenzie River, through EWEB's filtration plant, and then to our homes.

Wastewater

2 Goes from our homes, through the Wastewater Treatment Plant's process, and into the Willamette River.



Stormwater

Runs over roofs, streets, and driveways, through the storm drain system, and enters our rivers and creeks untreated.